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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference LPB/P101655WO	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/GB2004/001366	International filing date (day/month/year) 31.03.2004	Priority date (day/month/year) 01.04.2003	
International Patent Classification (IPC) or national classification and IPC C09J5/00, C09J5/08, B60J10/02, C08J9/32			
Applicant DE-BONDING LIMITED			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. sent to the applicant and to the International Bureau) a total of 8 sheets, as follows:
 - sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

Date of submission of the demand 01.03.2005	Date of completion of this report 06.07.2005
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Schlicke, B Telephone No. +31 70 340-1013



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/GB2004/001366

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-27 as published

Claims, Numbers

1-42 received on 03.03.2005 with letter of 01.03.2005

Drawings, Sheets

1/3-3/3 as published

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. The amendments have resulted in the cancellation of:

- the description, pages
- the claims, Nos.
- the drawings, sheets/figs
- the sequence listing (*specify*):
- any table(s) related to sequence listing (*specify*):

4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- the description, pages
- the claims, Nos.
- the drawings, sheets/figs
- the sequence listing (*specify*):
- any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superceded."

**INTERNATIONAL PRELIMINARY REPORT
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International application No.
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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

the entire international application,

claims Nos. 32-37

because:

the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (specify):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

no international search report has been established for the said claims Nos. 32-37

the nucleotide and/or amino acid sequence listing does not comply with the standard provided for in Annex C of the Administrative Instructions in that:

the written form

has not been furnished

does not comply with the standard

the computer readable form

has not been furnished

does not comply with the standard

the tables related to the nucleotide and/or amino acid sequence listing, if in computer readable form only, do not comply with the technical requirements provided for in Annex C-bis of the Administrative Instructions.

See separate sheet for further details

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
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Box No. IV Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees, the applicant has:
 - restricted the claims.
 - paid additional fees.
 - paid additional fees under protest.
 - neither restricted nor paid additional fees.
2. This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
 - complied with.
 - not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
 - all parts.
 - the parts relating to claims Nos. 1-31,38-42 .

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	8,10,13-15,17,18,22-25,27,39-42
	No:	Claims	1-7,9,11,12,16,19-21,26,28-31,38
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-31,38-42

Industrial applicability (IA)	Yes:	Claims	1-31,38-42
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.
PCT/GB2004/001366

Re Item IV

Lack of unity of invention

This International Examination authority found multiple groups of inventions in this international application, as follows:

- I A method of bonding/debonding two objects of an adhesive system, said system comprising an adhesive composition comprising an adhesive agent and/or primer and/or cleaner and thermoexpandable microspheres dispersed therein (claims 1,30,38,40). Furthermore, the adhesive system (claim 4), and a method of attaching a plurality of surfaces by using said adhesive system (claims 29,40).
- II An apparatus comprising an IR-emitting device comprising at least one bulb, at least one lens and at least one reflecting mirror.

The term "apparatus for attaching or detaching two or more surfaces" must be construed as meaning merely an apparatus suitable for attaching two or more surfaces. Since in addition no special technical feature in the sense of Rule 13.1 PCT is present, which could form a special technical link between the methods and the apparatus identified above, the present application is not considered as relating to a group of inventions so linked as to form a single general inventive concept in the sense of Rule 13.1 PCT.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

- 1 Reference is made to the following documents:

D1: WO-A-0075254 (BAIN P S; MANFRE G); 14.12.2000
D2: EP-A-1126001 (NITTO DENKO CORP), 22.08.2001

- 2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of independent claims 1,4,29,30,38 lacks novelty in the sense of Article 33(2) PCT.

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY
(SEPARATE SHEET)**

International application No.
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- 2.1 The document D1 discloses (claims; page 8, lines 1,2) a method of bonding and subsequently debonding vehicle windscreens. The method comprises the steps of a) applying an adhesive composition comprising I) an adhesive agent, ii) thermoexpandable microspheres encapsulating a blowing agent, having a diameter of 10 to 120 µm and an activation temperature of 80 to 170°C, and iii) an optionally encapsulated curing agent to a vehicle windscreen, b) allowing the composition to cure, c) applying a heat source to the cured adhesive in order to cause thermoexpansion of the microspheres and thus weaken the adhesive bond, and d) removing the windscreen.

Hence, the subject-matter of present claims 1,4,29,30,38 and 40 lacks novelty in view of this teaching (Article 33(2) PCT).

- 2.2 The document D2 discloses (claim 7; paragraphs [49],[52],[53]) a method of attaching and subsequently debonding a semiconductor wafer. The method comprises the steps of a) applying an adhesive composition comprising an adhesive agent, a crosslinking compound and thermoexpandable microspheres (Matsumoto F-50D®) encapsulating a blowing agent and having a diameter of appr. 15 µm and an activation temperature of 130°C to a vehicle windscreen, b) allowing the composition to cure, c) applying a heat source to the cured adhesive in order to cause thermoexpansion of the microspheres and thus weaken the adhesive bond, and d) removing the wafer.

Hence, the subject-matter of claims 4,29,30,38 lacks novelty in view of this teaching (Article 33(2) PCT).

- 2.3 The dependent claims do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step.

Claims

1. A method of bonding and debonding two or more surfaces or supports or layers of an adhesive system, the adhesive system comprising an adhesive composition at its bonded surface(s), the composition being placed between said surfaces or supports or layers, and the adhesive composition comprising an adhesive agent and/or a primer and/or a cleaner at its interface and dispersed therein at least two sets of thermoexpandable microspheres that are not simultaneously activatable, a first set of microspheres being associated with curing and bonding and a second set of microspheres being associated with debonding, in order to debond the system a sufficient power level of thermal radiation and/or thermal energy is provided which concentrates on the adhesive surfaces so as to expand the second set of microspheres in the adhesive and/or a primer and/or a cleaner layers and so causes weakening of adhesive surface forces at the interface of said layers in the adhesive system.
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15. 2. A method according to claim 1 wherein the power level of thermal radiation and/ or thermal conduction and/or thermal energy which passes through the adhesive composition causes the contents of the expanded microspheres to leach or migrate through their porous shells into the matrix of the composition.
20. 3. A method according to either claim 1 or 2 wherein the microspheres encapsulate a blowing agent which acts as a carrier for the contents of the microspheres.
25. 4. An adhesive system comprising curing an adhesive composition and/or debonding the same adhesive at its bonded surface, the composition being placed between two or more surfaces of supports or layers, and the adhesive composition comprising an adhesive and/or cleaner and/or primer at its interface and dispersed therein thermo-expandable microspheres the system comprising the steps of:
30. (i) activating a method of curing the composition by providing a first power level of thermal radiation and/ or thermal conduction and/or thermal energy

which passes through the adhesive composition so the contents of the expanded microspheres leach or migrate through their porous shells into the matrix of the composition and ;

(ii) de-bonding adhesive interfaces of the same surfaces of supports or

5 layers by providing a second power level of thermal radiation and/ or thermal conduction and/or thermal energy which concentrates on the adhesive surfaces so as to expand the microspheres in the adhesive and/or cleaner and/or primer layers and so cause weakening of adhesive surface forces in the interface of the adhesive composition.

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5. A system according to claim 4 wherein step (i) is performed after adhesive composition deposition and step (ii) is performed days, weeks, months or years apart.

15 6. A method or system according to any preceding claim wherein the microspheres comprise a co-polymeric shell which encapsulates an expanding agent for the debonding microspheres and a curing agent or catalyst mixed with an expanding agent for step the curing microspheres.

20 7. A method or system according to claim 6 wherein the expanding agent is selected from the group comprising an expandable gas, a volatile agent, a sublimation agent, water, an agent which attracts water or an explosive agent.

25 8. A method or system according to any of claims 2 to 7 wherein the microspheres encapsulating the curing agent have a larger cross sectional diameter than those encapsulating the expanding agent.

9. A method or system according to any of claims 2 to 8 further comprising a curing activator.

30 10. A method or system according to claim 9 wherein the curing activator is activated by an applied thermal energy or by its own energy.

11. A method or system according to any preceding claim wherein the adhesive is polyurethane or polyvinylchloride or an MS polymer or an epoxy resin.

12. A method or system according to any preceding claim wherein the microspheres are activated in a temperature range of about 45 to 220 °C for the debonding phase.

13. A method or system according to any of claims 2 to 12 claim wherein the proportion of microspheres encapsulating the curing agent are activated at a different temperature from those used in the debonding phase the temperature difference being between 20 to 100 °C.

14. A method or system according to any preceding claim wherein the microspheres used in debonding microspheres encapsulating the expanding agent comprise about 3-5% weight in the cleaner and 5-10% weight in the primer at the adhesive interface.

15. A method or system according to any one of claims 2 to 14 wherein the microspheres used in curing encapsulating the curing agent or catalyst comprise about 2-3% weight of the composition.

16. A method or system according to any preceding claim wherein the thermal radiation and/ or thermal conduction provided to the microspheres is provided by a means comprising a source of IR or UV electromagnetic radiation, or from a convection oven or from electrical means, a battery or a laser or from an ultrasonic source or from gas or from white light or microwaves or sonic waves.

17. A method or system according to claim 16 wherein in the instance of using IR radiation it is provided as a wavelength of about 800-1400 nm to 2000-6000 nm and concentrates heating radiation on the microspheres in order to reach their activation expanding temperature in advance of the adhesive matrix degradation temperature.

18. A method or system according to any preceding claim wherein the thermoexpandable microspheres are provided embedded in or coated on to a tape or mesh or film or attached to a wire or filament or fibre.

5 19. A method or system according to any preceding claim wherein the microspheres are coated in a black material.

10 20. A method or system according to any of claims 1 to 17 wherein the microspheres are coated with or encapsulate a monomer and/or with nanoparticles dispersed in the porous initial microsphere shell.

15 21. A method or system according to any preceding claim wherein the microspheres act as a vehicle or transporter or carrier or barrier or dispersing aid or aid to prevention of clustering of particles or nanoparticles or detergent or cleaning agent in a mixture comprising a binder and solvent, the microspheres either encapsulating a desired agent or being coated with it.

20 22. A method or system according to any preceding claim wherein the microspheres are dispersed in an arrangement of micro-wires so as to form a polygonal arrangement.

23. A method or system according to claim 22 wherein the micro-wires are about 100-200 μ in length.

25 24. A method or system according to claim 23 wherein the micro-wires are about 2-20 μ in diameter.

25. A method or system according to any one of claims 22 to 24 wherein the composition comprises about 1-10% volume of micro-wires.

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26. A method or system according to any preceding claim wherein the thermoexpandable microspheres are attached to a contact surface of one or more of the components which it is desired to attach and/or separate or on an internal surface of the components or at an interface of the cleaner and/or primer of said components.

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27. A method or system according to any preceding claim wherein the adhesive composition comprising the microspheres is provided in a continuous or discontinuous predefined or in spots in path or channel or groove or line or concentric circles provided substantially around the periphery of one or both of the contact surfaces of the items which it is desired to attach or detach.

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28. A method or system according to any preceding claim wherein the depth and breadth or thickness and wideness of the adhesive composition may be uniform or may vary as required in areas of the surface(s) which need to be attached or detached.

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29. A method of attaching or bonding two or more surfaces together comprising:

(i) applying an adhesive composition according to any preceding claim to one or more of the contact surfaces of each or all items which is to be bonded together; and

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(ii) supplying sufficient thermal radiation and/ or thermal conduction to the composition via contact with one or more of the contact surfaces of each or all items which is to be bonded together so as to cause a proportion of the thermoexpandable microspheres to expand and optionally to further release a curing agent into the composition during the bonding process.

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30. A method of detaching or debonding two or more surfaces that have been bonded together comprising, supplying sufficient thermal radiation and/ or thermal conduction to a surface having coated thereon or attached thereto the composition as defined in either claim 1 or claim 4, the thermal energy being supplied to one or more of the contact surfaces of each item which are to be detached/separated so as to cause

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the thermoexpandable microspheres to increase in volume and to become a pressure activator so as to debond the interfaces of the adhesion system.

31. A method according to claim 30 further including any one or more of the
5 features recited in claims 2 to 29 regarding the debonding of interfaces.

32. An apparatus for attaching or detaching two or more surfaces that have been bonded together comprising an IR emitting device comprising at least one bulb, at least one lens and at least one reflecting mirror mutually arranged so that heat is directed or focused only at an adhesive interface or a path where the
10 thermoexpandable microspheres are purposely present.

33. An apparatus according to claim 32 capable of emitting IR radiation in the range of about 800-1400 nm to 2000-6000 nm.

15 34. An apparatus according to either claim 31 or 32 that is automated and operably linked to a computer programme providing information to device sensors of an adhesive bonding path.

20 35. An apparatus according to any one of claims 32 to 34 mounted on a mobile unit so that it is free to follow a predefined adhesive bonding path.

25 36. An apparatus according to any one of claims 32 to 35 capable of concentrating an IR beam at certain partial points of the surface which it is desired to bond or de-bond in different steps at command.

37. An apparatus according to any one of claims 32 to 36 that is pre-programmed to follow a specific bonding path in direction, width and breadth.

30 38. A method of de-bonding an adhesive composition, the composition being present at an interface and being placed between two or more surfaces of vehicle

glazing or vehicle panel(s) or part(s) the composition comprising an adhesive or cleaner and/or primer and thermoexpandable microspheres dispersed therein the microspheres having a diameter of between 10-50 μm and an activation temperature range of between 110-210 $^{\circ}\text{C}$ and encapsulating at least one blowing agent the debonding being effected by exposing the microspheres power level of thermal radiation and/or thermal energy that results in a temperature received by the microspheres in the range of 110-210 $^{\circ}\text{C}$.

39. A method according to claim 38 further comprising curing the adhesive composition prior to debonding the curing comprising providing microspheres of 30-50 μm in diameter with an activation temperature range of between 50-100 $^{\circ}\text{C}$ the microspheres encapsulating a curing agent and/or catalyst and/or activator and effecting curing by exposing the microspheres power level of thermal radiation and/or thermal energy that results in a temperature received by the microspheres in the range of 50-100 $^{\circ}\text{C}$.

40. A method of curing an adhesive and de-bonding the same adhesive from automotive glazing or panels or parts comprising applying a composition comprising an adhesive and thermoexpandable microspheres dispersed therein, a first set of microspheres having a diameter of between 30-50 μm and an activation temperature range of between 50-100 $^{\circ}\text{C}$ and a second set of microspheres having a diameter of between 10-50 μm and an activation temperature range of between 110-210 $^{\circ}\text{C}$ the second set of microspheres being present at an interface of the adhesive or cleaner and/or primer, the composition being placed between two or more surfaces of the glazing or panel or part(s) and:

(i) activating curing of the composition by exposing it to a first power level of thermal radiation and/or thermal energy that results in a temperature received by the microspheres in the range of 50-100 $^{\circ}\text{C}$; and

(ii) de-bonding the adhesive system at its interfaces by exposing it to a first power level of thermal radiation and/or thermal energy that results in a temperature received by the microspheres in the range of 110-210 $^{\circ}\text{C}$.

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HARRISON GODDARD

CLMSPAMD

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41. A method according to any one of claims 38 to 40 further comprising any one or more of the features recited in claims 2 to 28.

42. A method according to any one of claims 38 to 41 for the removal of vehicle
5 glazing or panels or parts in an end of vehicle life process.

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P101655wo.amended claims

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